BLENDING OF MACHINE-STRIPPED COTTON
Preliminary Feasibility Studies

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Preliminary Feasibility Studies

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SUMMARY

Three methods of blending seed cotton to produce both single-variety and two-variety bales were investigated. (1) Two cotton varieties were fed simultaneously into a conventional seed-cotton-cleaning system at the gin. (2) Correct proportions of two cotton varieties were planted in adjacent rows and then harvested simultaneously. Pure lots of each variety were also harvested to serve as controls. (3) Single-variety and two-variety lots were layered on a specially developed belt feeder before being fed into a conventional suction unloading system at the gin.

The layering technique produced the most uniform and accurate blends, but all methods were workable. Predictable relationships between the characteristics of a blend and the proportions and properties of the ingredients were found. Most relationships were linear; the relationship with classer's staple length, however, appeared to be nonlinear. Market values for single-variety and two-variety bales indicated little incentive for farmers to mix varieties, either in the field or at the gin. These studies indicated that blending seed cotton to improve uniformity of fiber properties in the bale is technically feasible, but additional information is required to determine the economic feasibility of various types of blending systems.

INTRODUCTION

The blending of lint cotton is a standard procedure for most textile mills. Modern mills find it essential to blend 20 to 100 bales into an even-running lot for maximum processing efficiency and product quality.[1] Blending is designed to reduce the inherent variability of fiber properties within and among bales of cotton. Blending is also used to prepare specific mixes of lint for optimum spinning perform-

[1] Rusca, R. A., and Reeves, W. A. 1968. Utilization developments. *In* Elliot, F. C., Hoover, Marvin, and Porter, W. K., Jr. (eds.), Advances in Production and Utilization of Quality Cotton: Principles and Practices, pp. 487–525. Iowa State University Press, Ames.

ance and profits[2] and to profitably utilize certain discount cottons.[3] The value of lint-cotton blending is well established, and numerous blending techniques have been developed.

The blending of seed cotton (unginned cotton), however, is not a common practice in this country, although it is widely used in other parts of the world. As with lint cotton, there are advantages to blending seed cotton. The primary advantage is an improvement in uniformity of fiber properties within a bale and among bales of similar cotton. It is well documented that considerable variation in fiber properties exists among layers in a domestic bale of cotton.[4] This variation stems from uneven growth patterns in the field. Although some blending occurs in conventional harvesting and ginning processes, the extent of blending is not sufficient to level out the variations in fiber properties from layer to layer in a bale.

Broad variations in fiber properties also exist among bales from a given production area. There are presently 3,724 different combinations of grade, staple, and micronaire used by the U.S. cotton textile trade.[5] Because of this finely divided classification system and inherent variations from bale to bale, many types of bales are produced within a production area. This diversity in bale type makes it difficult for farmers and merchants to assemble uniform lots of cotton for marketing. It is possible that seed-cotton blending could be effectively used to decrease bale variability and improve the marketability of U.S. cotton.

Another possible advantage of seed-cotton blending would be the ability of farmers to blend different varieties of cotton to produce specific qualities. In some cases, seed-cotton blending would allow farmers to respond to urgent market needs more rapidly than they are presently able to do. Practical limitations exist for exploiting this advantage under our present marketing system. However, if this country ever adopts the practice of selling cotton as seed cotton, as is practiced in many parts of the world, blending different varieties of seed cotton to produce a desired quality would be possible.

These potential advantages warranted the investigation of seed-

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[2] LaFerney, P. E. 1969. Model for blending and processing cottons. *In* Summary Proceedings 1969 Cotton Quality and Processing Conference, pp. 16–19. National Cotton Council of America, Memphis, Tenn.

[3] Towery, J. D., Mouchet, R. L., and Arthur, H. E. 1972. Mechanical processing and blending techniques for short staple discount cottons. *In* Utilization of Discount Cottons in Major End Uses, pp. 27–35. U.S. Dep. Agric., Agric. Res. Serv. [Rep.] ARS 72-95.

[4] McCarty, J. W., Young, L. C., and Boteler, W. C. 1969. With-in bale variability of cotton. Final report, project No. B–1310, prepared for Cotton Producer's Institute. 40 pp. A. French Textile School, Georgia Institute of Technology, Atlanta, Ga.

[5] Commodity Credit Corporation, Schedule of 1972 upland cotton loan rates, Washington, D.C.

cotton blending to determine its feasibility and to develop some basic blending techniques. The studies reported here were conducted in 1971 and 1972 at Agricultural Research Service's South Plains Cotton Ginning Research Laboratory, Lubbock, Tex.

1971 STUDIES

Procedures

Two studies in 1971 were designed to determine if machine-stripped seed cotton could be blended in the gin's seed-cotton-cleaning system before entering the gin stand. The commercially grown varieties selected for each study differed in staple length and micronaire value. 'Tamcot 788' and 'Stripper 31' were utilized in the first study, and 'Paymaster 909' and 'Acala 1517V' were used in the second study.

A gin machinery array representative of gins that process machine-stripped cotton was used. The gin machinery sequence included an air-line cleaner, automatic feed control, tower drier (no heat), inclined cleaner, bur machine, tower drier (no heat), inclined cleaner, stick machine, extractor feeder, gin stand, two lint cleaners, and a press.

Blending of the seed cotton was accomplished by dividing the automatic feed-control hopper vertically into halves. Equal quantities of two varieties were accumulated in each half of the automatic feed control, and then both varieties were simultaneously metered into the seed-cotton-cleaning system. Thus, the blend was a 50–50 mixture.

The effect of blending on lint properties was measured by analysis of variance of the completely randomized experiment, consisting of three treatments, four replications, and five subsamples. The size of each replication was approximately one-half bale, with subsampling at five equally spaced layers near one side of the bale. The condition of the seed cotton prior to ginning was estimated from samples. Foreign matter in the blend was computed by sampling each variety before ginning and taking the average as representing the foreign matter in the blend before cleaning.

Results

Study No. 1.—Foreign matter and moisture contents for each variety and the blend are given in table 1. The amount of each foreign matter component was significantly different between varieties. Foreign matter content of the blend was between that of the individual varieties, but for each component the blend was statistically the same as one of the varieties. Moisture content was significantly different between varieties, while the moisture content of the blend was intermediate.

TABLE 1.—*Foreign matter and moisture contents of cotton samples, 1971*[1]

[Percent]

Study number and variety	Foreign matter content			Moisture content
	Burs	Sticks	Fine trash	
Study No. 1:				
'Tamcot 788'	25.8a	16.8a	9.2a	11.6a
'Stripper 31'	19.4b	12.8b	5.5b	9.7b
50–50 blend	23.5a	12.7b	5.8b	10.4a
Study No. 2:				
'Paymaster 909'	22.3b	9.0b	6.5b	7.5b
'Acala 1517V'	25.2a	13.8a	9.1a	8.6a
50–50 blend	22.3b	10.5b	7.9a	8.0ab

[1] Means in the same column for the same study followed by a common letter are not statistically different at the 5-pct level.

The mean values of seven of the nine lint properties in table 2 were significantly different among the two varieties and the 50–50 blend. There were no significant differences among means for elongation and nonlint content. Generally, the means of lint properties for the blend were intermediate to those of the two varieties. For example, the staple lengths of 'Tamcot 788', the 50–50 blend, and 'Stripper 31' were 32.1, 29.5, and 28.4 (32d inch), respectively. Means for the other properties followed a similar pattern.

The uniformity of lint properties is indicated in table 2 by the variance values. 'Tamcot 788' had significantly higher variance values than 'Stripper 31' for 2.5-percent span length, nonlint content, and grade index. The variance values of the 50–50 blend for these three properties tended to be between those of the two varieties. There were no significant differences in variance values among the varieties or blend for the other lint properties studied. These results indicated that 'Tamcot 788' was less uniform than 'Stripper 31' and that mixing the two varieties produced a lint blend with intermediate uniformity.

No comparisons were planned or intended between 'Tamcot 788' and 'Stripper 31'. Although both varieties were grown on the same farm, planting dates were different, and subsequent seasonal conditions caused differences in vegetative growth and fiber maturity, which affected the lint properties in table 2.

Study No. 2.—Foreign matter and moisture contents are summarized in table 1. As in study No. 1, the foreign matter and moisture contents of the blend were between those of the two varieties.

The mean values of lint properties for the blend were between those of the two varieties for each of the nine lint properties studied (table 3). The means were significantly different among the vari-

TABLE 2.—*Mean and variance values of lint properties for* 'Tamcot 788', 'Stripper 31', *and 50–50 blend*

[Study No. 1, 1971]

Lint property[1]	'Tamcot 788'	'Stripper 31'	50–50 blend
2.5-pct span length:			
Mean ....inch....	1.00a	0.83c	0.92b
Variance ....do.....	0.0006a	0.0001b	0.0004a
50-pct span length:			
Mean ....do.....	0.42a	0.37c	0.39b
Variance ....do.....	0.0002a	0.0001a	0.0001a
Uniformity:			
Mean ....pct....	41.7c	45.1a	42.9b
Variance ....pct....	0.8000a	0.4250a	0.7750a
Stelometer strength:			
Mean ....g/tex....	23.1a	19.7c	21.5b
Variance ....g/tex....	0.7655a	0.3077a	0.8582a
Elongation:			
Mean ....pct....	6.4a	6.8a	6.5a
Variance ....pct....	0.0510a	0.0397a	0.0385a
Nonlint content:			
Mean ....pct....	4.5a	3.7a	4.5a
Variance ....pct....	9.7945a	0.0367c	1.3287b
Grade index:[2]			
Mean	64.1c	86.2a	82.2b
Variance	59.05a	17.40b	7.43b
Staple length:			
Mean ....32d inch....	32.1a	28.4c	29.5b
Variance ....do.....	0.7000a	0.6500a	1.4750a
Micronaire reading:			
Mean	2.7c	3.5a	3.1b
Variance	0.0065a	0.0167a	0.0107a

[1] Means and variances followed by a common letter are not statistically different at the 5-pct level. Each mean is the average of 20 samples.

[2] All grades were reduced because of bark.

eties and the blend for six of the nine lint properties. These results were similar to those obtained in study No. 1.

The variance values were significantly different for nonlint content, with 'Acala 1517V' being more variable than 'Paymaster 909'. Variance values of grade index were significantly different among the varieties and the blend with 'Paymaster 909' having the lowest variance value, followed in order by 'Acala 1517V' and the blend. Although not statistically significant, 'Paymaster 909' tended to have lower variance values for all lint properties except stelometer strength and 50-percent span length. Likewise, 'Acala 1517V' tended to have higher variance values for all properties except stelometer strength, 50-percent span length, grade index, and micronaire. The variance values for the blend were intermediate for all lint characters except 50-percent span length, grade index, and micronaire.

TABLE 3.—*Mean and variance values of lint properties for 'Paymaster 909', 'Acala 1517V', and 50–50 blend*

[Study No. 2, 1971]

Lint property[1]	'Paymaster 909'	'Acala 1517V'	50–50 blend
2.5-pct span length:			
Mean ....inches....	0.94c	1.07a	0.99b
Variance ....do......	0.0001a	0.0002a	0.0003a
50-pct span length:			
Mean ....do......	0.43c	0.46a	0.44b
Variance ....do......	0.0001a	0.0001a	0.0001a
Uniformity:			
Mean ....pct....	45.1a	43.1b	43.8b
Variance ....pct....	0.5000a	1.000a	0.8000a
Stelometer strength:			
Mean ....g/tex....	21.9b	24.4a	22.7b
Variance ....g/tex....	0.9293a	0.5255a	0.6505a
Elongation:			
Mean ....pct....	7.5a	6.3c	6.8b
Variance ....pct....	0.0475a	0.0682a	0.0485a
Nonlint content:			
Mean ....pct....	3.2c	5.6a	3.9b
Variance ....pct....	0.0602b	1.2652a	0.1997ab
Grade index:			
Mean	93.6a	79.2c	85.2b
Variance	0.0000c	2.8000b	21.2000a
Staple length:			
Mean ....32d inch....	30.5c	33.0a	31.7b
Variance ....do......	0.2000a	0.9000a	0.5000a
Micronaire reading:			
Mean	3.1a	2.9b	3.0a
Variance	0.0037a	0.0045a	0.0062a

[1] Means or variances followed by a common letter are not statistically different at the 5-pct level. Each mean is the average of 20 samples.

Large variations in grade caused by high bark content in some of the samples resulted in high variance values in grade index. None of the lint samples of 'Paymaster 909' was reduced in grade because of bark content, while all lint samples from 'Acala 1517V' were reduced one grade because of high bark content. For the blend, 11 of 20 lint samples received grade reductions, because of high bark content.

Composite samples of lint from each replication in this study were evaluated in a small-scale spinning test. The general pattern of the spinning test results in table 4 was similar to the previously discussed lint property data in that the mean of the 50–50 blend fell between those of the varieties for all yarn properties. The within-replication variance could not be calculated for the different yarn properties because subsampling was not utilized.

TABLE 4.—*Yarn properties of* 'Acala 1517V', 'Paymaster 909', *and 50–50 blend*

[Study No. 2, 1971]

Yarn property[1]	'Acala 1517V'	'Paymaster 909'	50–50 blend
Picker and card waste........pct...	11.0a	7.1b	7.6b
Yarn strength:			
22s yarn ....lb...	120.8a	101.3c	109.8b
50s yarn ....lb...	45.5a	34.0c	40.0b
Yarn elongation:			
22s yarn ....pct...	6.7a	6.8a	6.6a
50s yarn ....pct...	4.9a	4.6b	4.9a
Average break factor	2,466a	1,964c	2,207b
Average appearance index	70b	90a	87.5a
Yarn imperfection number:			
22s yarn	119a	59c	74b
50s yarn	88a	42c	54b

[1] Means in a row followed by a common letter are not statistically different at the 5-pct level.

1972 STUDY

Procedures

Two methods were used to blend 'Paymaster 18' and 'Tamcot 788' cotton varieties: Gin blending and harvest blending. Each method was used to prepare three different blends of the two varieties. Additional pure lots of each variety were blended by each method to serve as controls. The harvest-blended pure-variety lots represented seed cotton harvested and handled in a conventional manner. The gin-blended pure-variety lots represented normally harvested seed cotton that had been homogenized during gin blending. Percentages of the two varieties in the test lots prepared by each method are given in the footnotes to table 5.

Both cotton varieties were produced in double rows planted on 40-inch beds at the Texas A&M Research and Extension Center, Lubbock. The two varieties for gin blending were produced on adjacent 2-acre plots. The cotton for harvest blending was produced on five 1-acre plots. Two plots were required for producing the pure-variety lots, and three plots were required for the blends. A 160-inch-wide, finger-type, mechanical stripper was used to harvest four beds simultaneously. The 50–50 blend was produced by harvesting two beds each of 'Paymaster 18' and 'Tamcot 788'. The 25–75 blends were produced by harvesting one bed of one variety along with three beds of the other variety.

A specially constructed belt feeder was used for gin blending (fig. 1). The belt feeder, mounted on a standard 9-ton trailer chassis, was driven back and forth underneath a separator. Seed cotton discharg-

TABLE 5.—*Fiber and yarn properties of* 'Paymaster 18' *and* 'Tamcot 788' *blends*[1]

[1972 study]

Fiber or yarn property	Blends[2]				
	P	Pt	pt	pT	T
Grade index	94.2	93.8	92.5	91.0	90.2
Staple length ......32d inch	30.3	31.7	32.1	32.4	33.0
Micronaire reading	3.3	3.2	2.9	2.8	2.7
2.5-pct span length ......inch	0.92	0.95	1.00	1.02	1.05
50-pct span length ......inch	0.42	0.43	0.43	0.44	0.45
Uniformity ......pct	46	45	43	43	43
Stelometer strength ......g/tex	20.8	21.5	22.4	23.7	24.7
Nonlint ......pct	3.4	3.4	3.7	4.0	4.2
Reflectance ......R_d	79.3	79.2	79.3	79.9	79.5
Yellowness ......$+b$	8.8	9.0	9.2	9.0	9.1
Pressley strength ...1,000 lb/in^2	74.4	77.1	80.4	82.6	85.9
Picker and card waste ......pct	9.3	8.2	8.2	9.2	8.8
Neps/100 in^2 of web	20.7	22.5	24.2	26.6	27.9
Yarn skein strength ......lb	89.9	95.1	102.3	104.0	116.9
Yarn appearance index	100	103	100	103	110
Yarn break factor	1,929	2,056	2,229	2,332	2,596
Uster nonuniformity ......pct	21.7	21.0	19.9	20.2	18.7
Single yarn strength ......lb	364	384	394	409	427
Single yarn elongation ......pct	7.2	7.1	6.7	6.7	6.5
Yarn strength variation ......pct	12.4	9.8	10.1	11.3	9.9

[1] Fiber properties are averages of both gin and harvest blending. Yarn properties are averages for gin blending only.

[2] P = 100 pct 'Paymaster 18' (control).
T = 100 pct 'Tamcot 788' (control).
Pt = 75 pct 'Paymaster 18' and 25 pct 'Tamcot 788'.
pt = 50 pct 'Paymaster 18' and 50 pct 'Tamcot 788'.
pT = 25 pct 'Paymaster 18' and 75 pct 'Tamcot 788'.

ing from the separator accumulated in layers on a wire belt at the bottom of the belt feeder.

One of the trailer wheels was chain-driven by a ½-hp electric gearmotor at a speed of 6 r/min (fig. 2). A manual reversing switch was used to reverse the motor rotation in order to move the belt feeder forward and backward. A guide-and-roller assembly kept the trailer chassis moving in a straight line and prevented side creepage (fig. 3). The linear speed of the belt feeder was approximately 20 ft/min. This system formed 10 layers of cotton from each bale when loaded at a rate of 6 bales per hour. The traversing movement was stopped after one bale of cotton had been loaded onto the belt.

For unloading and feeding into the gin, the belt was actuated to convey the seed cotton into a feed mechanism located at the rear of the belt feeder. The cotton was then fed directly into the gin's con-

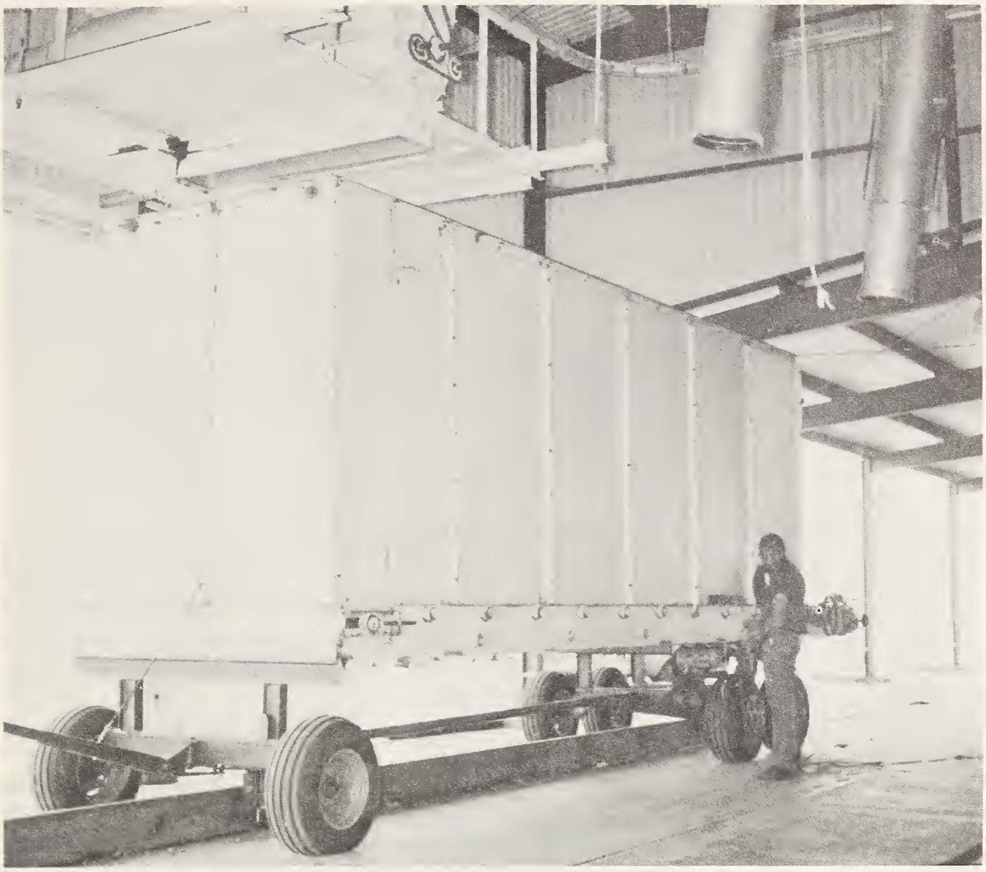

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FIGURE 1.—Belt feeder in position for loading.

ventional suction unloading system. The feed mechanism consisted of five spiked cylinders that loosened the compacted cotton to facilitate feeding into the air line. The cylinders were driven by a 7½-hp motor at speeds of 490 r/min. The belt was driven at a speed of 1¼ ft/min to produce an unloading rate of 6.7 bales per hour.

Blend proportions were controlled by weighing the amounts of the two cotton varieties loaded onto the belt. The required weights of each variety were loaded separately, one on top of the other. Blending was accomplished by simultaneously feeding the two varieties through the feed mechansim into the gin's unloading system.

Test lots produced by both blending methods were ginned together in a randomized order. Ginning procedures were those normally required for stripped cotton. The seed-cotton-cleaning process consisted of 16 cylinders of cleaning, a bur machine, a stick machine, and an extractor-feeder. All cotton was ginned on one stand at an average rate of four bales per hour. The ginned lint was cleaned by two stages of saw-type lint cleaning.

Fifteen lint samples were taken from each bale for determination of selected fiber properties. These samples were withdrawn from

equally spaced layers across the entire bale of lint. Six-pound spinning samples were also taken from the bales that had received gin blending. These samples were composites of specimens withdrawn from each of the 15 layers. Standard fiber and spinning tests were performed at Texas Tech University's Textile Research Center, Lubbock.

The primary objectives of these tests were to study the fiber and yarn properties of seed-cotton blends and to compare the two methods of blending with respect to effectiveness. Fiber and yarn properties were studied by comparing averages among blends and by regression analysis. Effectiveness of blending was evaluated on the basis of sample variability and accuracy of blend proportions.

Results

Average fiber and yarn properties are given in table 5. 'Tamcot 788' had the longest and strongest fibers and produced the highest quality yarn. 'Paymaster 18' had the highest micronaire reading and the lowest nonlint content. There was little difference in color (reflectance and yellowness) between the two varieties. 'Paymaster 18'

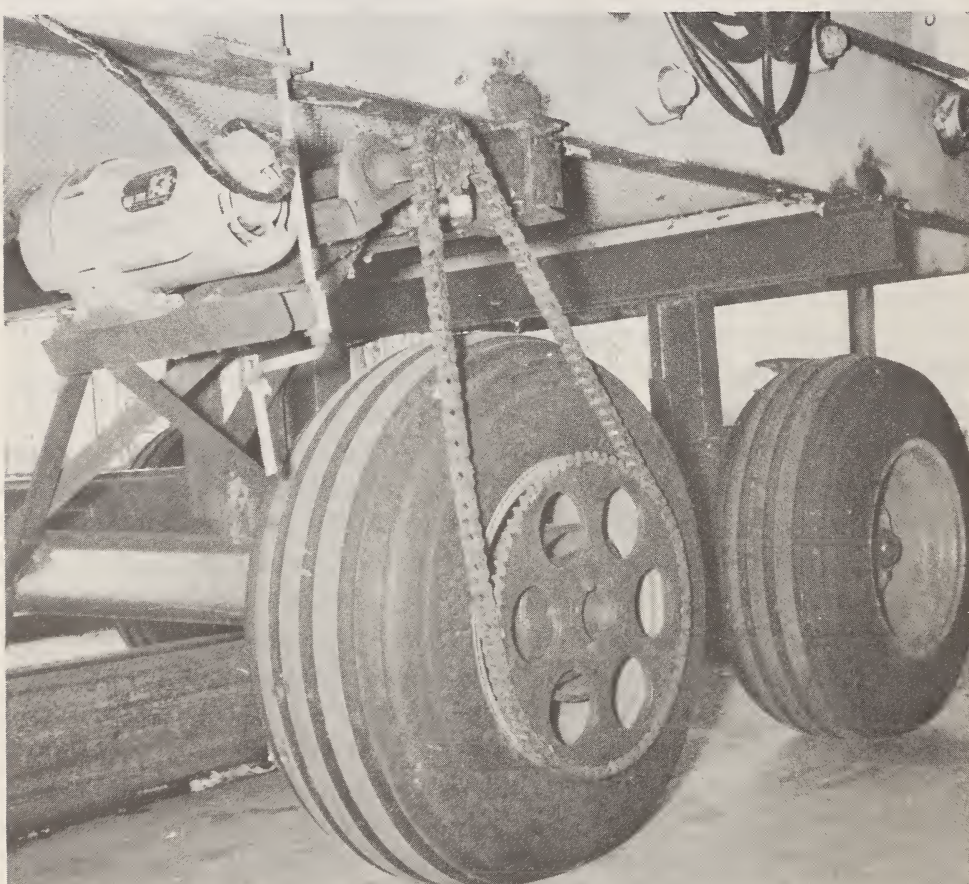

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FIGURE 2.—Drive system for belt feeder.

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FIGURE 3.—Guide-and-roller assembly.

graded slightly higher than 'Tamcot 788' because of its lower nonlint content (fig. 4). Properties of the blends were intermediate between those of the pure varieties.

Regression analyses showed that most of these properties followed a linear pattern that was proportional to the blend ingredients (table 6 and fig. 5). However, staple length did not follow a linear pattern (fig. 6). It appeared that the classer's staple length was longer than warranted for the 75–25 and 50–50 percent blends of 'Paymaster 18' and 'Tamcot 788'. Linear regressions for reflectance, yellowness, picker and card waste, yarn appearance, and yarn strength variation did not adequately explain variations in these properties. No significant higher order regressions could be determined for any of these properties. However, it should be noted that differences between varieties in reflectance, yellowness, and picker and card wastes were small, so the blends would not be expected to differ significantly. 'Tamcot 788' produced yarn of higher appearance index than did 'Paymaster 18' or any of the blends. Yarn appearance was approximately equal for 'Paymaster 18' and the three blends. Yarn strength variation ranged from 9.8 to 12.4 percent, but did not appear to follow any definite trend. This analysis showed that simple equations could be used to predict properties of seed-cotton blends from the known properties and proportions of blend ingredients.

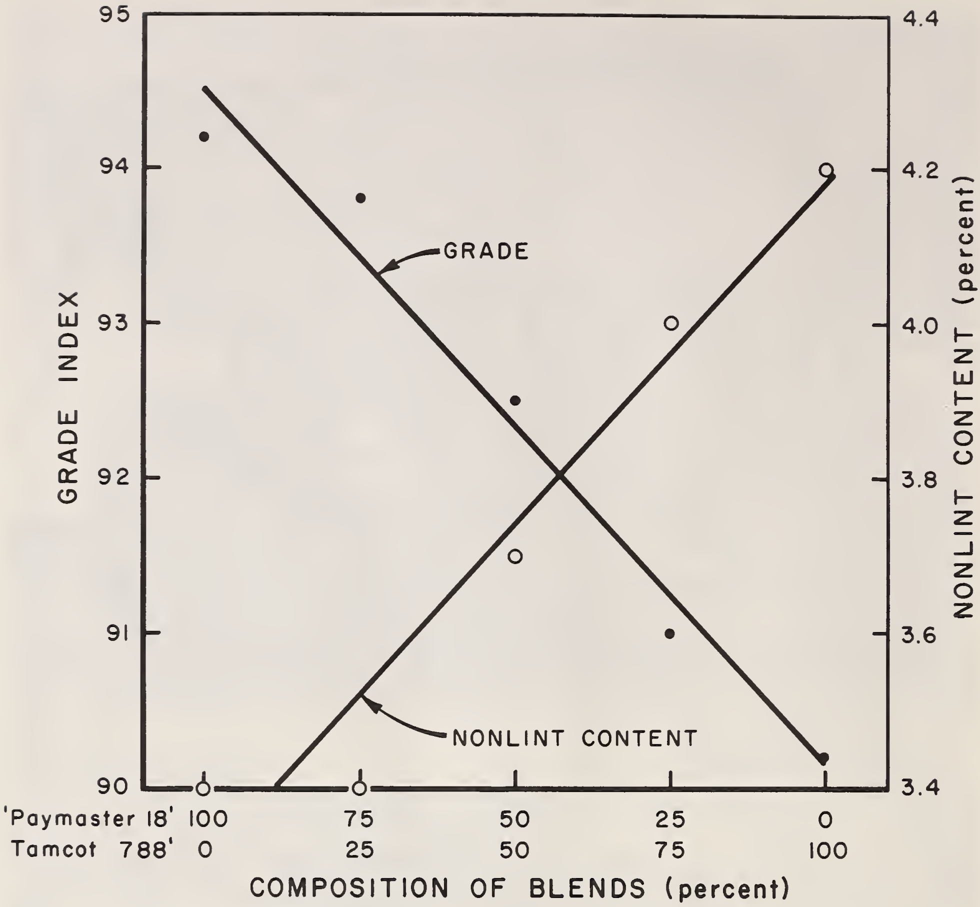

FIGURE 4.—Grade index and nonlint content of five blends, 1972.

Variances were calculated for each group of 15 samples taken from each pure-variety bale (table 7). The gin-blended varieties were horizontally layered into the belt feeder and fed lengthwise into the ginning system. The harvest-blended varieties were dumped into a trailer and unloaded at the gin with a standard suction telescope. Table 7 shows that the gin-blended varieties tended to have lower variances than the harvest-blended varieties, indicating that the layering technique used in gin blending was homogenizing the seed cotton and producing a more uniform bale of lint.

Further evidence of the homogenizing effect can be found by examining the distribution of classer's grades and staple lengths (table 8). The modal grade for all cotton was Strict Low Middling (SLM). Eighty-four percent of the gin-blended samples were classified in the modal grade category, while only 68 percent of the harvest-blended cotton samples received this classification. In a similar manner, 60 percent of the gin-blended samples and 41 percent of the harvest-blended samples received the modal staple length (32/32d of 1 inch) classification. These results showed that the layering

technique used in gin blending was superior to conventional harvesting in improving uniformity within a bale of lint.

The accuracy of obtaining the target blend proportions was evaluated by comparing the individual regressions determined from Stelometer strength measurements on cotton blended by the two test methods. The Stelometer strength property was chosen because of its high linear correlation to blend proportions. The multiple-correlation coefficients (r^2) for these regressions were 0.99 for the gin-blended cotton and 0.98 for the harvest-blended cotton. This is an indication that gin blending was more accurate than harvest blending.

The proportions used in gin blending were determined by actual seed-cotton weights. In harvest blending, the proportions were determined by the number of rows of each variety harvested with one pass of the stripper. If the varieties in adjacent rows had not yielded exactly the same amount of cotton, the exact target proportions

TABLE 6.—*Regression analyses of yarn and fiber properties*[1]

[1972 study]

Fiber or yarn property	Linear regression			r^2	Significance level (pct)
	Unit	Y-intercept (a)	Slope (b)		
Grade	Index	90.2	4.3	0.97	1
Staple length	32d inch	33.01	(2)	.99	5
Micronaire	Reading	2.64	0.65	.93	1
2.5-pct span length	Inch	1.05	−0.13	.98	.1
50-pct span length	do	0.45	−0.03	.91	5
Uniformity	Percent	42.48	3.08	.89	5
Stelometer strength	Gram/tex	24.63	−4.04	.99	.1
Nonlint	Percent	4.18	−0.88	.95	1
Reflectance	R_d	79.7	......	.39	(3)
Yellowness	$+b$	9.13	......	.35	(3)
Pressley strength	1,000 lb/in²	85.8	−11.4	.99	.1
Picker and card waste	Percent	8.74	......	0	(3)
Nep/100 in² of web	Number	28.1	−7.4	.99	.1
Yarn skein strength	Pound	114.2	−25.2	.94	1
Yarn appearance	Index	107	......	.60	(3)
Yarn break factor	Factor	2,550	−644	1	.1
Uster nonuniformity	Percent	18.95	2.68	.90	5
Single yarn strength	Pound	426.0	−60.5	.99	.1
Single yarn elongation	Percent	6.52	0.66	.92	1
Yarn strength variation	do	10.0	......	.22	(3)

[1] $Y = a + bX$, where Y = property, $a = Y$ − intercept, b = slope, and X = percent 'Paymaster' + 100. Regression was determined from averages of both gin and harvest blending for fiber properties and from gin-blending averages for yarn properties.

[2] A 3d-order polynominal regression was selected to describe staple length, $Y = 33.01 - 4.22X + 8.46X^2 - 6.93X^3$.

[3] Not significant.

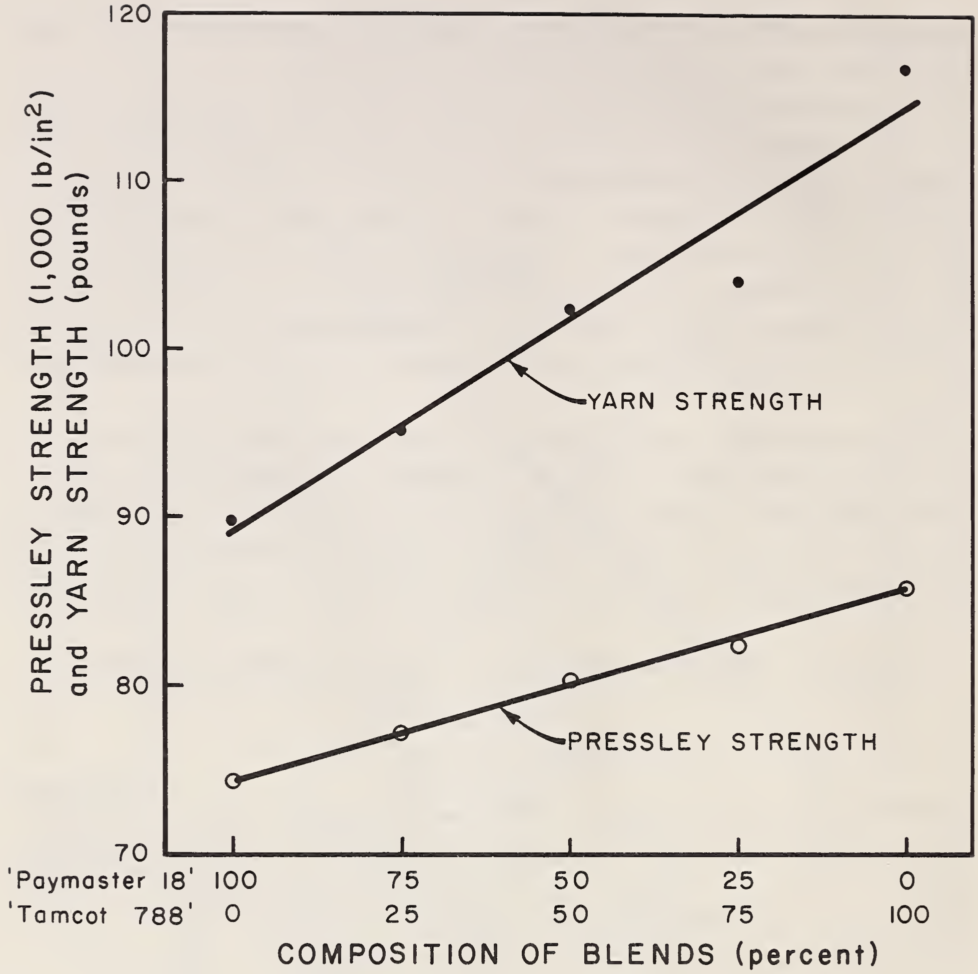

FIGURE 5.—Pressley strength and yarn strength for five blends, 1972.

would not have been obtained. Since differences in yields among varieties are common, it is to be expected that harvest blending would produce less accurate blends than gin blending.

Another factor should also be considered with respect to blend accuracy. Lint turnout, if different for two varieties, could have a significant effect on the resulting blend proportions, even if the seed cotton were accurately weighed before blending. Lint turnout varies among varieties and is affected by growing and harvesting conditions.

ECONOMIC CONSIDERATIONS

Blending to improve the uniformity of single-variety bales or to produce blends of several varieties raises questions concerning the economics of such operations. Although these studies were not de-

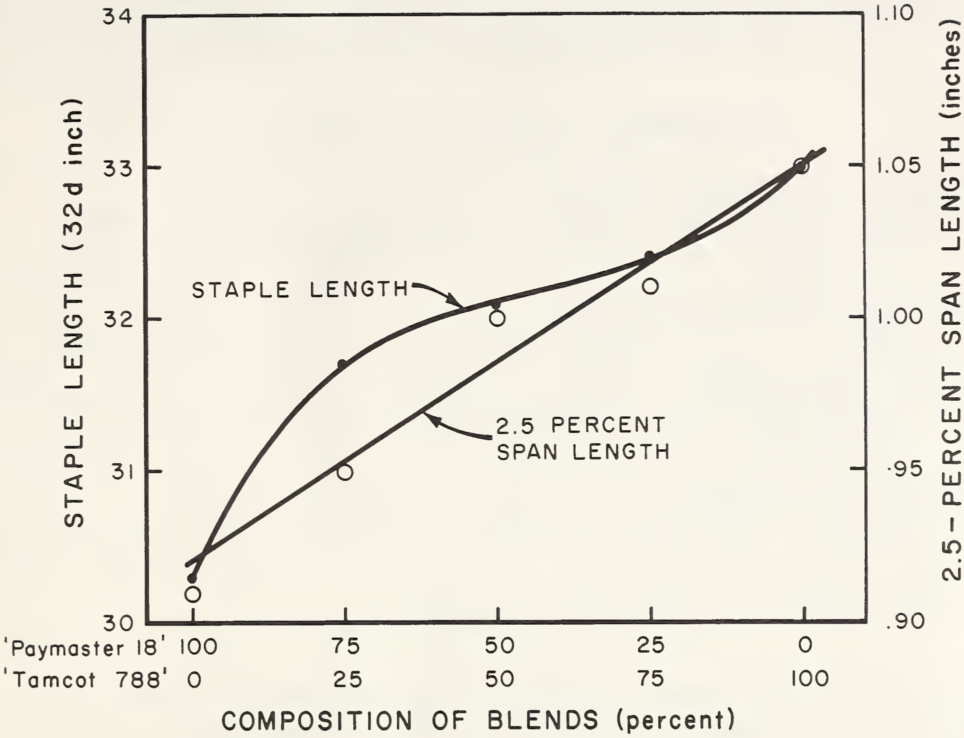

FIGURE 6.—Staple length and 2.5-percent span length for five blends, 1972.

TABLE 7.—*Variance values of 15 samples from pure-variety bales, 1972*

Fiber property	'Paymaster 18' Gin-blended	'Paymaster 18' Harvest-blended	'Tamcot 788' Gin-blended	'Tamcot 788' Harvest-blended
Micronaire reading	0.0021	[1]0.0125	0.0045	[1]0.0102
Stelometer strength	.2074	[1].4338	.4455	.5721
2.5-pct span length	.0002	.0002	.0001	.0002
50-pct span length	.0001	.0001	.0001	[1].0003
Uniformity ratio	1.2095	.9238	.3523	.5714

[1] Sample variance of the harvest-blended bale was significantly higher than variance of the corresponding gin-blended bale at the 95-pct level of confidence.

signed as an economic analysis of blending, certain information related to economics was obtained. It was possible to calculate and compare bale values for all cotton blended. Also, the equipment and operating costs of the belt feeder were estimated.

Bale values based on 1971 and 1972 Commodity Credit Corporation loan prices are given in table 9. The bale values of the two varieties used in study No. 1 (1971) were $75.68 and $53.65 when calculated on an individual basis. The average value of these two bales

TABLE 8.—*Distribution of classer's grades and staple lengths for two blending methods and all test lots, 1972*

Classification	Gin blending	Harvest blending
Classer's grade designation:		
Highest grade	SLM	SLM
Modal grade	SLM	SLM
Lowest grade	LM	LM
Frequency of modal grade samples ... pct	84	68
Classer's staple length:		
Highest length ... 32d inch	34	34
Modal length ... do	32	32
Lowest length ... do	30	30
Frequency of modal grade samples ... pct	60	41

SLM Strict Low Middling. LM Low Middling.

was $64.67. The value of the 50–50 blend of these two varieties was $64.43, or 24 cents per bale less than the average bale value of individual varieties. In study No. 2 (1971), bale values of the individual varieties were $78.56 and $64.67. These bale values averaged $71.62. The 50–50 blend of these varieties was valued at $72.57 per bale, or 95 cents per bale more than the average value of the single-variety bales.

In 1972, the two varieties were valued individually at $75.68 and $70.65. The average value of these individual varieties was $73.17. The bale value of the 50–50 blend of these two varieties was $72.09, or $1.08 per bale less than the average value of the indivdual varieties. Thus, in two studies the 50–50 blend was worth slightly less than the average value of the individual varieties, and in one study the 50–50 blend was valued at 95 cents more than the individual varieties.

In 1972, the blend combination of the 25-percent long-staple, low-micronaire cotton and the 75-percent short-staple, high-micronaire cotton produced a bale value higher than either of the individual varieties. The bale value of this combination was $77.36, or $2.94 per bale more than the $74.42 weighted average of the two individual varieties. This increase in value was due primarily to a higher-than-warranted staple-length designation for this blend combination (fig. 6). The blend combination of 25-percent short-staple cotton and 75-percent long-staple cotton produced a bale value lower than either individual variety. The bale value of this blend was $67.30, or $4.61 per bale less than the appropriate weighted average ($71.91) of the individual varieties. This loss in value was due to the staple

length being classified approximately one thirty-second inch shorter than the long-staple variety, while the micronaire and grade discounts remained constant.

TABLE 9.—*Bale loan values for cotton blends*[1]

Year	Blends[2]				
	$100V_1$	$75V_1 25V_2$	$50V_1 50V_2$	$25V_1 75V_2$	$100V_2$
1971:					
Study No. 1	$75.68	.....	$64.43	.....	$53.65
Study No. 2	78.56	.....	72.57	.....	64.67
1972	75.68	$77.36	72.09	$67.30	70.65

[1] Loan values are based on Commodity Credit Corporation loan prices for 1971 and 1972.

[2] Numbers indicate percentages of each variety (V_1 and V_2) used in blends. In each case, V_1 refers to the variety with the shortest staple length, while V_2 refers to the longest staple length variety.

TABLE 10.—*Estimated costs of a gin-blending system utilizing seed-cotton layering*

[12-bale-per-hour gin]

Item	Cost
Equipment:	
2 4-bale capacity hopper-feeders, complete	$50,000.00
2 separators, complete	12,500.00
Centrifugal fan, complete	2,500.00
Piping	2,000.00
Track and guides	2,000.00
Trailer shed extension, 2,000 ft^2	12,000.00
Installation of equipment	4,000.00
Total installed cost	85,000.00
Depreciation[1]	5,670.00
Capital charges[2]	3,400.00
Insurance and taxes	1,400.00
Operating costs:[3]	
Annual volume of 5,000 bales	3,160.00
Annual volume of 7,500 bales	4,240.00
Annual volume of 10,000 bales	5,320.00
Average annual cost per bale:[4]	
Annual volume of 5,000 bales	2.73
Annual volume of 7,500 bales	1.96
Annual volume of 10,000 bales	1.58

[1] 7 pct annually on equipment and shed extension, based on a useful life of about 14 years.

[2] 8 pct annually on one-half of the investment.

[3] Includes labor costs (at $2.50/hour) for 1 employee to operate hopper-feeder, electric power costs (at $0.03/W) for 75 hp, and a maintenance cost of $1,000 annually.

[4] Includes depreciation, capital charges, insurance, taxes, and operating costs.

This information does not show much financial incentive for mixing cotton varieties in the field or at the gin. In these studies, there were more instances where the blended mixtures were worth less than the pure varieties. Thus, these studies illustrate that indiscriminate mixing of varieties can, in many cases, reduce the value of the cotton to the farmer instead of increasing it.

The estimated costs of a system for blending seed cotton at the gin by the layering techniques developed in these studies are given in table 10. These estimates were based on an hourly ginning capacity of 12 bales per hour and an annual volume of 5,000 to 10,000 bales. These estimates show a total investment of $85,000 for equipment, trailer shed extension, and installation charges. Total annual costs per bale, including depreciation, interest on investment, insurance, taxes, labor, power, and maintenance, were estimated to range from a high of $2.73 for a 5,000-bale volume to a low of $1.58 for a 10,000-bale volume.

In order for blending to be profitable, it would be necessary for blended bales to increase in value to offset these additional costs. These studies indicate that the increased value would have to accrue from improved uniformity within and among bales of similar cotton. Sufficient data were not available in these studies to determine the monetary value of improved uniformity.

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